

Direct-To (D2)
Overview Description
January 31, 2002

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**TECHNICAL RESEARCH IN ADVANCED AIR
TRANSPORTATION TECHNOLOGIES**

**Final
Overview Description**

Direct-To (D2)

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**AATT OPERATIONAL CONCEPT FOR ATM – YEAR 2002
UPDATE**

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ACKNOWLEDGEMENT

The majority of the descriptions presented in this document have been taken directly from the NASA documents shown in the bibliography. Minor modifications have been made to the text to provide readability. The Direct-To Functional Flow chart, however, has been independently developed for this description. This approach to the development of this document was taken in order to remain faithful to the efforts that are presently being undertaken by the NASA AATT Project Office, the D2 Tool Developers and the associated NASA AATT contractors.

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AATT DIRECT-TO (D2) OVERVIEW DESCRIPTION

1. DESCRIPTION

Purpose

Provide clearance advisories for time- and fuel-saving direct routes.

Users

En Route radar controllers

Field Sites

Fort Worth Air Route Traffic Control Center (ARTCC)

Operational Results

- Potential for a Direct-To tool was discovered unexpectedly during field tests of the CTAS Conflict Probe and Trial Planner functions at Denver ARTCC (Sept. 1997) and Fort Worth ARTCC (Nov. 1998).
- Controllers pointed out a preferred use of the Trial Planner: searching for conflict-free direct routes.
- Potential savings in flying time for Fort Worth ARTCC airspace has been estimated at approximately 1,800 minutes per day, or about 2.5 min. per Direct-To clearance advisory.
- An analysis of Direct-To at other ARTCC facilities in the NAS shows similar potential for savings.
- Operational field test conducted during the Summer 2000 at Fort Worth ARTCC.

Overview

The Direct-To Controller Tool identifies aircraft that can save at least one minute of flying time by flying direct to a down-stream fix along its route of flight. A list ordered by time savings is presented on a display for the controller, showing the call sign, equipment suffix, time savings, Direct-To fix, wind-corrected magnetic heading to the fix, and conflict status for eligible aircraft within a controller's sector. A point-and-click button next to the call sign on the Direct-To List activates a trial planning function that allows the controller to quickly visualize the direct route, choose a different fix if necessary, and automatically input the direct route flight plan amendment to the Host computer. The Direct-To List is strictly advisory and the controller may issue the direct route as advised, modify the direct route or remove the advisory depending on traffic conditions or other factors. The Direct-To Tool was implemented in CTAS by adding one additional process to the existing software architecture for the TMA. Figure 1 illustrates the D2 display.

Over 35 controllers from 9 different en route centers participated in the development of the Trial Planner, which is an integral part of the Direct-To user interface. A team of controllers from Fort Worth ARTCC has participated in the development of Direct-To from its inception in 1998. Controller simulations of Direct-To at NASA Ames (August 1999) and the FAA William J. Hughes Technical Center (February 2000) have resulted in positive feedback from controllers

and airspace users. Controller workload for flight plan amendments is reduced from 20+ head-down keyboard entries to 2-3 head-up mouse clicks. Controller productivity is improved as well since Direct-To advises only timesaving direct routes.

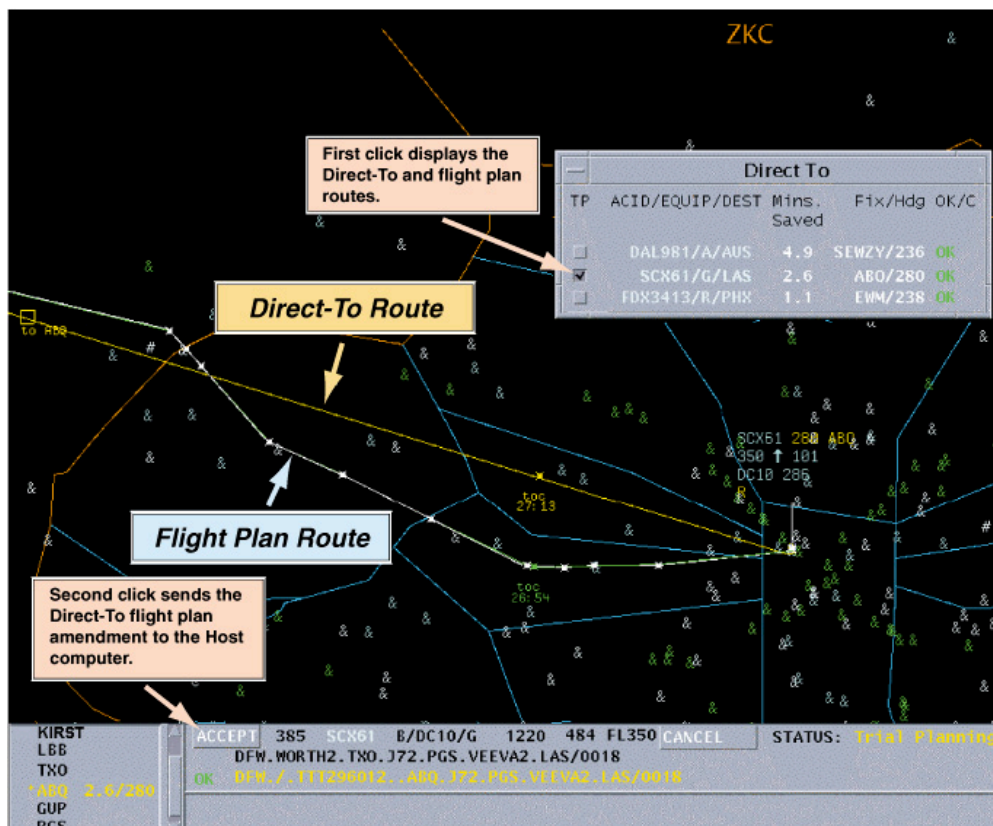


Figure 1. D2 Display

Accounting for the wind field is an essential element of the Direct-To algorithm. CTAS receives hourly updates of the National Oceanic and Atmospheric Administration's Rapid Updated Cycle atmospheric model, which represents the highest accuracy wind model currently available. For each candidate aircraft, CTAS computes the time to fly to the Direct-To fix along the flight plan route and the time to fly direct to the fix. If the savings along the direct route is greater than one minute, the clearance advisory is added to the Direct-To List. Figures 2 and 3 illustrate operational demonstrations of the Direct-To tool at Denver Center in September 1997 and at Ft. Worth Center in November 1998.

2. OPERATIONAL CONCEPT

The controller interface for the Direct-To Tool has been designed to be accessible from the controller's display monitor. It employs a graphical user interface similar to software running on workstations and personal computers. With the Direct-To Tool, the controller selects items from menus and sends flight plan amendments from the controller display to the Host computer



Figure 2. Denver Center



Figure 3. Ft. Worth Center

using point-and-click actions executed with a mouse or track ball. Experience gained from field tests of the CTAS Conflict Probe/Trial Planner established strong controller preference for a point-and-click graphical user interface that minimizes, if not altogether eliminates, the time-consuming keyboard entries currently in use. An efficient and controller-friendly interface not only will ensure controller acceptance of the Direct-To Tool but also will increase the likelihood that controllers will use the Tool when the opportunity arises. For a Tool such as this, whose use is not safety-critical but is essentially voluntary, a friendly and low workload interface provides the main incentive for controllers to use it. The Tool interface consists of the Direct-To List, point-and-click executable commands, and graphical display of trajectories.

Controllers who have evaluated the List in shadow mode with live traffic from the Fort Worth Center do not consider the conflict status as the definitive accept/reject criterion for issuing a direct-to clearance. Instead, they base their decision to issue a direct-to clearance on their overall assessment of the traffic situation, their knowledge of the airspace as well as the conflict status shown in the List. These controller opinions reflect a basic characteristic of this decision support tool, namely that the information provided by the Tool is advisory only and as such is not a substitute for good controller judgment. Thus, the controller should always augment the advisory information provided by the Tool with analysis of the traffic situation before issuing a direct-to clearance.

The Trial Planner provides the controller with special tools and interactive graphics for managing the trajectories of aircraft in climb, cruise, and descent. With few exceptions, all interactions with the Trial Planner are conducted by point-and-click actions with the mouse (or trackball). Thus, “head down” keyboard entries are almost entirely eliminated. Conflict probing using the CTAS conflict detection algorithm is an integral part of the Trial Planner. The Trial Planner allows the controller to put any aircraft, not just aircraft in the Direct-To List, in trial planning mode. The Conflict Probe/Trial Planner has been evaluated in field tests at the Denver Center and the Fort Worth Center. The Trial Planner provides the ability to evaluate and select any one of numerous alternatives to the trajectories generated by the direct-to algorithm. Controllers found the ability to easily change the direct-to fix to be a useful feature, especially when the direct-to trajectory shows a conflict. These conflicts can sometimes be resolved by choosing a direct-to fix that is either up-range or down-range of the advised direct-to fix or it may be resolved by creating an auxiliary waypoint, or adding an altitude amendment. In

summary, the integrated capabilities of the Direct-To List and Conflict Probe/Trial Planner provide an effective environment by increasing controller productivity and reducing workload.

3. FUNCTIONAL FLOW

Figure 4 illustrates the detailed functional flow of D2 operating in the ARTCC and depicts the functional interfaces with external data sources. The input/output sources, appearing in double boxes, are shown in the figure. The major functions within D2 are:

- Data Acquisition and Processing
- Aircraft List Management
- Trajectory Generation
- Time Savings Estimation
- Conflict Detection
- Trial Planning
- Display Message Processing

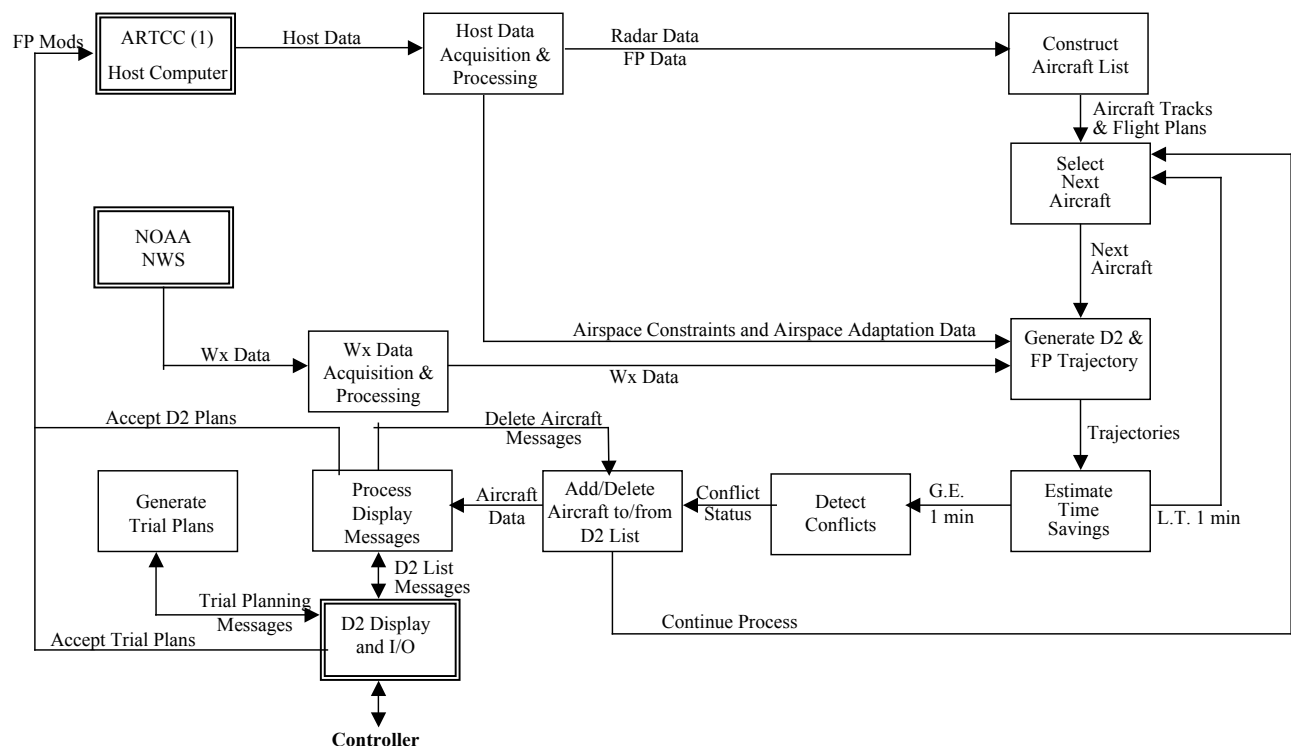


Figure 4. D2 Functional Flow Diagram

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